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Upagrah

News Letter

Vol. 46, Issue 2
Apr-June, 2017

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विमानपुर, बेंगलूरु – 17

ISRO SATELLITE CENTRE
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While Writing

Prof. U R Rao,
Architect of Indian Satellite Programme

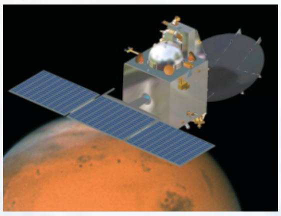
Professor U R Rao, Former Chairman-ISRO / Secretary-Department of Space, left us for his heavenly abode in the early morning, on July 24, 2017 at his residence in Bengaluru. He led ISRO for 10 years during 1984-1994.

Dr. K.N. Shankara

Dr. K.N. Shankara, Former Director ISAC, departed from us on July 17, 2017 at his residence in Bengaluru. He led ISAC during 2005-2008.

Director ISAC, Upagrah team and ISAC employees deeply mourn the sad demise of Prof. U R Rao & Dr. K.N. Shankara

MARS ORBITER MISSION COMPLETES 1000 DAYS OF OPERATION IN SPACE

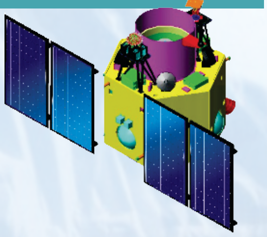


Mars Orbiter Mission (MOM), ISRO's maiden attempt set out on its journey on November 5, 2013 and reached the red planet after a number of critical maneuvers on September 24, 2014.

MOM has successfully completed 1000 days in its orbit as on June 19, 2017, surviving well beyond its designed mission life of six months. All Scientific payloads continue to provide valuable data of Mars surface and its atmosphere and resulted in around 20 scientific papers in peer reviewed journals. The archived scientific data has been released to public. About 1380 registered users have downloaded more than 370 GB of data.

This highly challenging mission is the most economical interplanetary mission to date. On this memorable day of completion of 1000 Earth days around Mars, Programme Director, IRS & SSS congratulated all ISACians for their efforts in making this mission a grand success.

PSLV-C38 SUCCESSFULLY LAUNCHES CARTOSAT-2 SERIES SATELLITE AND 30 SATELLITES IN A SINGLE FLIGHT



PSLV-C38/Cartosat-2 Series Satellite Mission was launched on June 23, 2017 from SDSC SHAR, Sriharikota.

Cartosat-2 Series (weighing 708.5 kg) Satellite is the primary satellite carried by PSLV-C38. This remote sensing satellite is similar in configuration to earlier satellites in the series with the objective of providing high-resolution scene specific spot imagery.

The images obtained from the satellite are useful in variety of applications requiring high resolution images, which include cartography, infrastructure planning, urban & rural development, utility management, natural resources inventory & management, disaster management

FIRST DEVELOPMENTAL FLIGHT OF INDIA'S GSLV MKIII SUCCESSFULLY LAUNCHES GSAT-19 SATELLITE

GSAT-19 satellite was launched by GSLV Mk III-D1 on Monday, June 05, 2017 from the Second Launch Pad (SLP) at Satish Dhawan Space Centre SHAR (SDSC SHAR), Sriharikota.

GSAT-19 satellite with a lift-off mass of 3136 kg, is the communication satellite of India, configured around the ISRO's standard I-3K bus. GSAT-19 carries Ka/Ku-band high throughput communication transponders. Besides, it carries a Geostationary Radiation Spectrometer (GRASP) payload to

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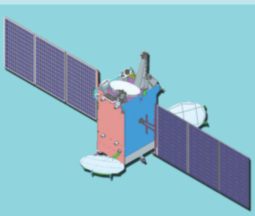
ACHIEVEMENT

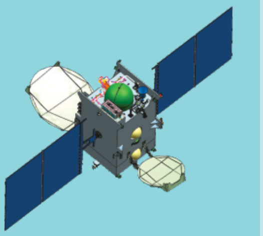
monitor and study the nature of charged particles and the influence of space radiation on satellites and their electronic components. GSAT-19 also features certain advanced spacecraft technologies including miniaturised heat pipe, fibre optic gyro, Micro Electro-Mechanical Systems (MEMS) accelerometer, Ku-band TTC transponder, as well an indigenous Lithium-ion Battery.



GSLV SUCCESSFULLY LAUNCHES GSAT-9

GSAT-9 was launched by GSLV-F09 on Friday, May 05, 2017 from the Second Launch Pad(SLP) at Satish Dhawan Space Centre SHAR (SDSC SHAR), Sriharikota.

GSAT-9 is a Geostationary Communication satellite realized by India. The primary objective of GSAT-9 is to provide various communication applications in Ku-band with coverage over South Asian countries. GSAT-9 is configured around the ISRO's standard I-2K bus. With lift off mass of 2230 kg the main structure of the satellite is cuboid in shape built around a central cylinder. GSAT-9 carries communication transponders operating in Ku-band.



EDITORIAL MESSAGE

The historical launch of GSLV-MKIII carrying GSAT19 added another proud moment in the list of ISRO's achievements. In addition to this, in the second quarter of 2017, few other launches were also achieved: the GSAT-17 in June 2017 from Kourou, Cartosat-2 along with 30 small satellites in June 2017 by PSLV C-38 and the launch of GSAT-9 by the GSLV in May 2017.

For all these laudable achievements, team Upagrah congratulates all the project teams involved in achieving the mission objectives and bringing the proud moments for ISRO. Upagrah acknowledges 'THREE' successful GEO missions in a month.

A featured article on “GSAT-9” is presented in this issue, giving the details of how the vision took a leap into reality.

The article on the achievements of 6th Cartosat-2 series satellite, its high resolution images and the details of the GSAT-17, ISRO's biggest communication satellite so far, are discussed with details.

Readers can find brief technical notes on the Lander sensors' for Chandrayaan-2 and a host of details on various facilities at ISAC.

Other activities like the “International Yoga Day”, “Satellite Technology Day – 2017”, “EEE Conference” and “Dr. Ambedkar Jayanthi Celebration” at ISAC have kept us rejuvenating amidst the buzzing activities. Also the felicitation to the employees for their 25 years of service to the organization and the felicitation to three women employees of ISAC as “Rocket Woman of India 2017” are very encouraging.

Upagrah, along with its readers, bids farewell to the superannuating employees and wishes them a happy and healthy retired life.

Team Upagrah, looks forward to your valuable comments and views.

Dr. Anil Agarwal, Chairman, Upagrah Editorial Board.

“ROCKET WOMAN OF INDIA 2017"

Smt. K.N. Saraswathi

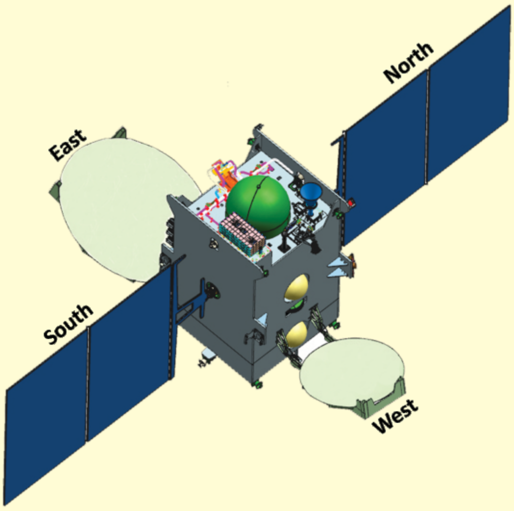
Smt. R Selvi

Smt. Parvathy Shankar

Confederation of Indian Industries (CII) felicitated three Women employees of ISAC, Ms. K N Saraswathi, Senior HPS, Ms. R Selvi, Head, TED/SEG and Ms. Parvathy Shankar, Head, DCTES/TED/SEG on 3rd March 2017 towards their significant contribution in ISRO. They were conferred with the title "Rocket Woman of India”.

GSAT-9 SATELLITE: THE VISION TAKES A LEAP INTO REALITY

About two and half score ago, our beloved founder Dr. Vikram Sarabhai envisioned "...But, we are convinced that if we are to play a meaningful role nationally, and in the community of nations, we must be second to none in the application of advanced technologies to the real problems of man and society...". This vision felt a touch of reality when our Honourable Prime Minister Shri. Narendra Modi, while complementing ISRO scientists on occasion of the successful PSLV-C23 launch, said "...India is rooted in our age old ethos of *Vasudeiva Kutumbakam* – the whole world being one family. ...We must therefore, share the fruits of our technological advancement, with those who do not enjoy the same. ...The developing world and our neighbours, in particular. ...A satellite that we can dedicate to our neighbourhood, as a gift from India. ...". And so when the clock ticked 16:57hours on 5th May 2017, GSLV-Mk2 – *the naughty-turned-obedient boy* – in *his* 2nd operational mission F09, embracing *his dear sister* GSAT-9, roared into the clear sky from Second Launchpad of Satish Dhawan Space Centre at Sriharikota and bid *her* adieu at the elliptical Geostationary Transfer Orbit for a safe haven ahead; thereby, spiralling the vision into reality.

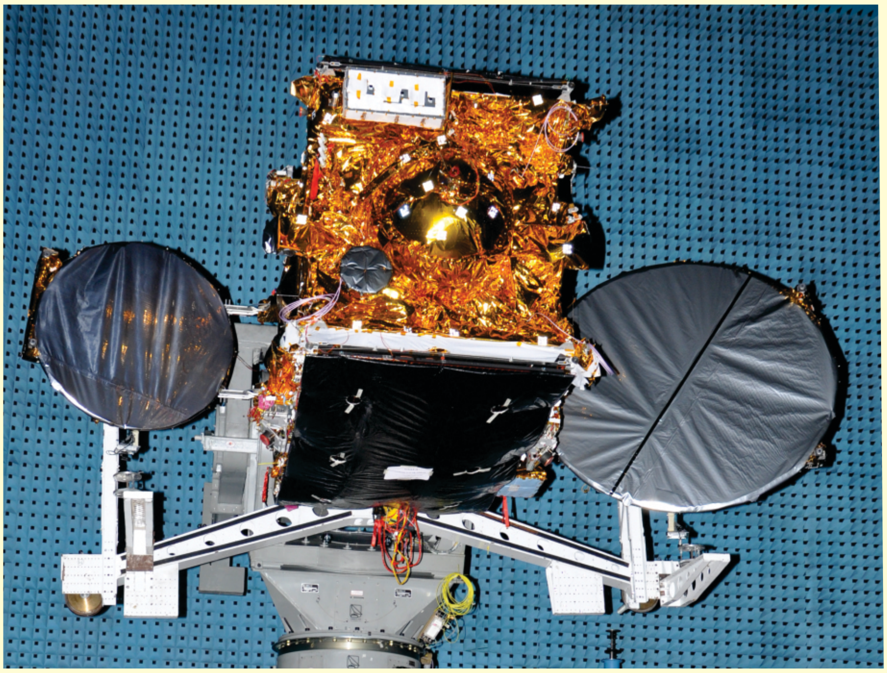


Artist Impression of GSAT-9 in Orbit

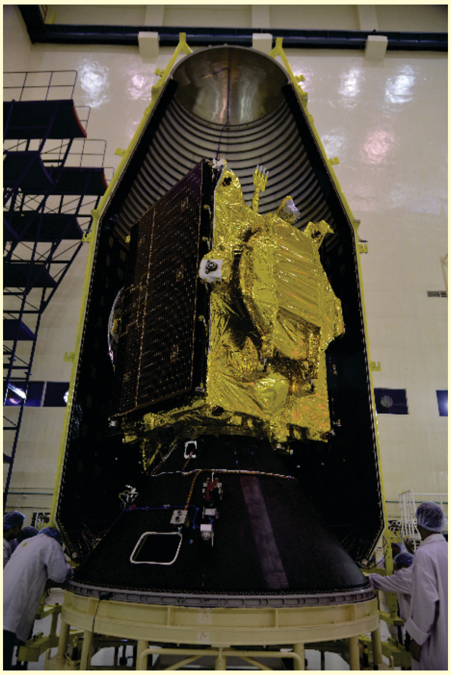
GSLV-F09 lifts off from Second Launchpad at Satish Dhawan Space Centre

GSAT-9 satellite will provide fixed satellite communication services in Ku-band with coverage over the South Asian Countries, during its intended mission life of over 12 years. The satellite will enable the member countries to establish SATCOM based services; such as Television/DTH, VSAT, e-governance, Banking, Tele-medicine, Tele-education, etc. It has potential utilization for supporting various broadcasting and intercative telecommunication applications like Disaster Management, Broadcast of Meteorological Data, Networking of academic, scientific and research institutions; thus, strengthening the regional cooperation among the member countries.

Weighing 2230kg at lift-off with a dry mass of 976kg, GSAT-9 is built around ISRO's heritage I-2k bus with minor modifications for catering to two new technologies aboard an Indian satellite, viz. Electric Propulsion System (EPS) and Telemetry, Tracking & Commanding (TTC) in Ku-band. The Payload System comprises of four receivers in 4/2 redundancy, twelve Ku-band 140W radiatively cooled Travelling Wave Tube Amplifiers (TWTAs) and two deployable single shell reflectors of 1.4m dia Rx and 2.0m*2.2m elliptical Tx, respectively, on West and East sides of the satellite. Two standard I-2k type Solar Arrays, generating about 3kW of electric power, serve the Payload and Mainframe Systems. In addition to Eclipse support, two 90Ah Lithium-ion Batteries also support the EPS power requirements. A new EPS bus is formed, for this purpose, by diode OR'ing the pole points of the Discharge Relays. For the first time in ISRO, an experiment aboard GSAT-9 will monitor the on-orbit operating temperatures of the Solar Cells and their power degradation due to ageing using two dedicated Solar Cells mounted on innermost Solar Panels of both Arrays. A novel thermal control design, for handling thermal dissipations from indigenous Momentum Wheels, is configured on East side of the satellite; consisting of two Radiator Panels and interconnecting Heat Pipe network, which takes advantage of seasonal Solar Flux variations. All other Mainframe Systems derive heritage from earlier missions.



GSAT-9 Satellite undergoing CATF Test



GSAT-9 encapsulation with Payload Faring

In addition to conventional Chemical Propulsion System (CPS) used for Orbit-raising and Station Keeping (SK) operations; GSAT-9 is also configured with an Electric Propulsion System (EPS) as a technology demonstrator for North-South SK providing 4 years mission life during first 6 years, based on power availability. 27kg of Xenon gas, filled in a 30 liter tank, forms the fuel for EPS. Redundant to each other; the Pressure Regulation Systems, viz. Electronic (EPR) and Mechanical (XMPR), adjust the flow of Xenon to four 18mN Keldysh-make Stationary Plasma Thrusters (SPTs). Powered using EPS bus, different designs of Power Processing Units (PPUs) provide the required electric power to the SPTs. While ISAC-make PPU powers the two South side SPTs, LPSC-V make PPU supplies to the two North side SPTs. Also, a Control Electronics Package for EPS (NCT-10) includes an onboard auto sequencer algorithm for carrying out closed loop EPS operations. NCT-10 houses two additional cards to cater to the Telemetry and Telecommand requirements of EPS, as well. Although envisaged for SK operations, EPS operations were successfully demonstrated during Station Acquisition (STAQ) Manoeuvres on 12th, 13th and 14th May 2017.

GSAT-9 also carries Ku-band TTC system for On-Orbit phases, besides the heritage C-band TTC which is used for Transfer Orbit operations. Transmit and Receive signals of Ku-band TTC are routed through the Receive section of the Payload System. Further, the Phase Modulated Telemetry RF Carriers will also aid as Ku-band Beacons for satellite tracking by ground users. Ku-band TTC system was characterized during the In-Orbit Testing (IOT) of the satellite's payloads on 23rd May 2017 and nominal performance was recorded.

GSAT-9 has undergone many configuration modifications since its inception, making it an exemplary for management of configuration changes. Detailed studies were carried out to address the requirements arising from these changes, while ensuring safety and minimal impact to the other subsystems. The capabilities of I-2k bus in terms of accommodation, thermal dissipation and power margins are pushed to their limits; displaying the robustness in ISRO's satellite system designs.

Moments after its successful launch, a *summit* was held with the Prime Minister's Office and the leaders of other South Asian Countries in Video Conference mode. In his introductory remarks, our Prime Minister congratulated Team ISRO on the successful launch of GSAT-9 and called for peace, progress and prosperity in the South Asian region saying "...This launch tells us that even the sky is not the limit when it comes to regional co-operation. ...A promise to extend the advanced space technology for the cause of growth and prosperity of South Asia. ...Our coming together is a sign of our unshakable resolve to place the needs of our peoples in the forefront. ...". All leaders of the other South Asian Nations together voiced in lauding India for this *out of world* gift, expressly quoting the Prime Minister of Bhutan "...This gift from India is an example of true friendship and co-operation. ...Launch of this satellite, our satellite, augurs well for our region. ...". This is just the beginning ...

-V. DeSouza, Project GSAT-9, GEOSAT Programme

CARTOSAT- 2 SERIES SATELLITE

The sixth spacecraft of Cartosat 2 series was launched on 23rd June 2017 by India's fortieth flight PSLV-C38 with 30 Co-Passenger Satellites (total weighing 243 kg). The spacecraft realization and launch took place in less than 130 days from the launch of launch of previous spacecraft in its series. Spacecraft initial phase operations are in progress, spacecraft onboard performance is normal.

This satellite is similar to last two spacecrafts of Cartosat-2 series built with high resolution panchromatic camera and 4-Band Multispectral camera operating in *'Time Delay Integration (TDI)'* mode. It has capability to image scene specific spots and longer strips images with a GSD of 0.64 m in panchromatic camera mode and better than 2m in multispectral camera mode with a swath of 10 km. Both Pan and Multispectral camera can acquire the image data simultaneously. This is a three-axis stabilized agile spacecraft can provide spot images of the desired location and has the capability of along track steering to provide stereo spot imageries and across track steering up to± 26 deg to enhance the range of spot imageries. It also carries two Event Monitoring Cameras Ev1 (0.5m Monochrome) and Ev2 (0.4 m RGB) to provide video imagery of ground events with sub meter sampling. Data handling chain is designed for Pan and Ev2 Camera OR Mx and Ev1 operation by selection of common compression and formatter system chain. The overall mass of the satellite is 708.5 Kgs with propellant mass of 75 Kg and the power generation capability is around 986 Watts. Spacecraft has been realized with heritage systems of earlier Cartosat-2 series spacecrafts.

The spacecraft's nominal altitude is 505Km. This spacecraft is phased with other satellites in its constellation can provide revisit of less than 2 days.

The system modification in this mission are , both the blocks of non-canted thrusters are realized with indigenous thruster bed heaters developed by LPSC (B), In-house designed 12 Channel SPS systems (M & R).Launch pad initialization commands loading through EEPROM has been demonstrated for the first time to reduce the uplink load.

Similar to other Cartosat Satellites Inertial reference unit (IRU) and all Mark-II Star sensors are used as attitude sensors. Reaction wheels, Thrusters and torquers are used as actuators. Star sensors are operated in dual head mode of operation for location and target accuracy improvement. The telescope structure is built with indigenously (CMSE) designed and qualified composite structure similar to the last satellite.

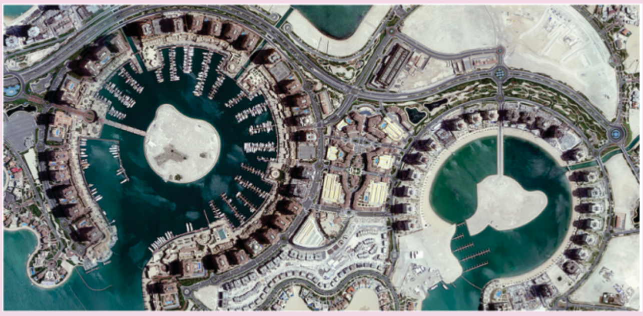


Figure 1 Doha, Qatar captured on 26-06-17

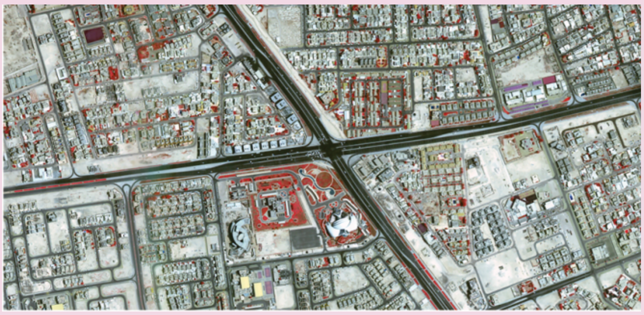


Figure 2 Thumama, Doha, Qatar captured on 26-06-17

All new features of earlier two satellites of cartosat 2 seires like TDI operation of detectors, AOS commanding, Macro mode of operations, LP sequencing, Eclipse drag mode, DWT based compression, Sliding redundancy of DH systems, Fusion mode of star sensor operations, Payload modes, have been implemented in this satellite.

The spacecraft is currently delivering quality imageries in Panchromatic and Multispectral bands similar to previous Cartosat 2 series satellite. The image data sent by the satellite will be useful for cartographic applications, urban and rural applications, coastal land use and regulation, utility management like road network monitoring, water distribution, creation of land use maps, change detection to bring out geographical and manmade features and various other Land Information System and Geographical Information System applications

M A Sadananda Rao,
Project Director-Cartosat-2/3 series

GSAT-17 COMMUNICATION SPACECRAFT

ISRO has been consistently expanding its network of services, thereby bringing India to the forefront in the domain of space achievements. Adding a feather to this prestigious cap is GSAT-17, which is ISRO's biggest communication satellite. Weighing around 3475 kg at launch pad, this spacecraft is the heaviest spacecraft built by ISRO so far. Further to this, satellites with higher Lift off mass are being realised under I6K category.

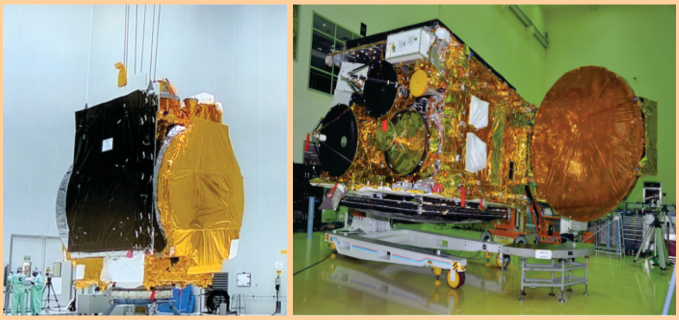
This spacecraft is configured on ISRO's proven standard I-3K bus and carries 42 transponders in multiple payload bands. The payload comprises of 24 Normal C band transponders and 12 Upper extended C band transponders, 2 Lower extended C band transponders, 2 Forward (CxS) and 1 Return (SxC) links in MSS and 1 DRT/SAS&R payload. This spacecraft is aimed to provide replacement for the Nor-C and Ext-C services of INSAT-3A and INSAT-4B. It will also provide continuity to the MSS services currently being offered by INSAT-3C.

With the advancement in the field of space technology, few new elements are implemented in GSAT-17. Both intermediate decks have embedded heat pipes for better thermal control. The East and West DGRs have four hold down mechanism to meet the dynamic frequency requirements. Apart from this, it is for the first time, MSS payload is designed using indigenous Digital filters along with Saw filters. These Digital Flexible Bandwidth Filters (DFBF) provide onboard re-configurability in frequency spectrum and have sharp cut-off filtering characteristics thereby providing ease in operations.

The lower extended C band coverage provides connectivity between the Southern Indian peninsula and the Antarctica region. To do so, along with the transponders, two separate patch array antennae, consisting of 4x8 elements were accordingly designed to transmit and receive data between these two ISRO stations.

The realization of GSAT-17 in stipulated time has been very challenging which was achieved through the meticulous efforts of the teams from various centres across ISRO. Of the many challenges posed, the major one was the accommodation of EV top antennae. Being the heaviest satellite in the I3K family with multiple payload bands, there were four payload (0.7 m, 0.9 m, 0.75 m, Patch array) and two TTC antennae (Omni & Global horn), located on EV. All three Earth Sensors are also located on EV panel and the Field of View (FOV) clearances in presence of all these elements on a single panel was a real major challenge that was handled efficiently.

KEY FEATURES OF GSAT-17	
Orbital slot	93.5°E
Payload	Nor-C- 24 Channels U Ext-C – 12 Channels L Ext-C – 2 Channels MSS – 2 Forward+1 Return link DRT & SAR-1 transponder
Bus platform	Standard I3K
Power Demand	~ 6kW
Eclipse Support	2 X 144AH Li-Ion Batteries
Lift Off mass	3475.5 kg
Mission life	~15 years
Launcher	Ariane-5
Launch	28th June 2017 @21:15 UT



All the LEOP operations have been carried out successful from Master Control facility at Hassan and the health of spacecraft is as nominal. The In-Orbit Testing (IOT) of spacecraft is also completed successfully.

With this, GSAT-17 will go a long way in meeting contingency requirements and providing services to existing users. In addition it will augment and support existing telecommunication, MSS, VSAT and other satellite based services in the country.

Farhana Tabassum, GPMSG, ISAC

PUBLICATION

Hindi article titled “अंतरिक्ष प्रौद्योगिकी आधारित परिशुद्धता खेती” (Space Technology based Precision Farming), authored by Smt. Deepika Jindal (SQAD/SSQG) and Sh. Rajiv R. Chetwani (Director, Information Systems Programme Office, ISRO Hqs) was published in the prestigious national magazine - Vigyan Pragati (June 2017 issue).

GSAT-19 OVERVIEW

A next generation spacecraft to be launched successfully by a generation next launcher was the dream of all of us at ISRO. The dream was fulfilled on 5th June 2017 at 1728 Hrs when GSLV MARK III D1 lifted off majestically from SHAR with GSAT 19 mounted atop the launcher. After magnificent 17 minutes flight, GSAT 19 spacecraft was injected into GTO with a precision. ISRO created history with the success of this mission.

GSAT 19 is an advanced communication satellite developed and launched by ISRO. The payloads in this spacecraft are quite different from the existing communication spacecrafts. Except the fact that the spacecraft bus is an I3K bus, all other technologies in the spacecraft are new. There are more than fifteen new technologies which are flown and being validated in this spacecraft. In fact the spacecraft can easily be called a test laboratory in Space. Another striking feature is that this kind of new and complex spacecraft is conceived and developed within a short span of one year. This is a testament of the technical expertise and managerial acumen that we have across various centres of ISRO.

GSAT-19 is the first High Throughput Spacecraft (HTS) developed by ISRO. These kind of spacecraft have just started appearing on the horizon in Europe and USA. We have also joined the league of HTS with GSAT 19. These spacecrafts are highly spectral efficient, nominally operate in Ka / Ku bands and provide large amount of bandwidth in space using the multi spot beam and frequency reuse concept. GSAT 19 is fore-runner of a series of advanced communication satellites with multi-spot beam antenna coverage over regions of Indian mainland as well as islands to meet the fixed satellite service requirements of user community. GSAT 19 will provide about 4.2 Gbps of capacity. This spacecraft is closely being followed by another big HTS spacecraft GSAT 11, which will provide four times the capacity of GSAT 19.

GSAT-19 is configured to provide services in Hub based star network mode in which user terminals communicate in Ku-band. Hub links will communicate with the satellite in Ka-band, thus making the payload operating in a hybrid Ka x Ku/Ku x Ka configuration. There are a total of 2 spatially separated Hub beams communicating with 8 spatially separated Ku-band beams. Each Hub communicates with 4 user beams. Closed loop antenna tracking system using a tracking receiver and beacons is implemented to provide antenna pointing accuracies of better than 0.05 degree.Payload has a number of new developments in Ku and Ka band including CFRP with aluminum lining feeds and 3D printed feeds The main advantage of these spacecrafts is two way connectivity provided to the users which can bring revolution in broadband connectivity, VSAT and backhaul linking for various applications. These spacecraft can also be deployed to provide triple play services.

The spacecraft also has Radiation Spectrometer (GRASP) payload. This payload is used to measure the energy and density of charged particles in the transfer and Geo orbit. This data will be very useful in designing and development of sensitive electronic systems for space applications.

There are two new thermal experiments namely Loop Heat pipe experiment which is designed to see the effectiveness of flexible heat pipes required for efficient transfer of thermal energy. In addition, miniature heat pipe experiment will validate the use of this kind of heat pipes on the electronic packages directly.

Apart from payload, the spacecraft also accommodates advanced spacecraft technologies and bus subsystem indigenous experiments. 70V fully regulated bus with 1 KW battery discharge regulator module is qualified and flown first time onboard GSAT-19. All the 70 V DC-DC converters on the spacecraft are indigenously designed and developed . A 100 AH indigenous battery using VSSC developed Lithium Ion cells and indigenous developed Bus bars are also flown for the first time on a spacecraft. In addition, this spacecraft has fiber optic gyro, MEMS based accelerometer, Dual head Mark III star sensor, Micro CASS systems developed by LEOS. A new Ku band TTC RF system with patch array antenna has also found a place on the spacecraft.

The total lift off mass of spacecraft is 3136 Kg and spacecraft will generate 4.5 KW of power having a life span of more than ten years.

Pradeep Kumar Gupta, Project Director

CHANDRAYAAN-2
LANDER SENSORS PERFORMANCE TEST (PHASE-1&2)

Chandrayaan -2, India's second mission to the moon aims for a precise, soft and safe touchdown of the Lander on the Lunar surface. Chandrayaan-2 Composite Module comprises of an Orbiter, Lander and Rover weighing 3300 kgs at lift off. GSLV –MkII will carry Chandrayaan-2 Composite Module and place it in an Elliptical Parking Orbit (EPO) of 170 x 20000 km. Subsequently, the Orbiter through a series of Earth Burns (EBN) increases the apogee height to bring the orbit close to the moon. At an appropriate time, a Trans Lunar Injection (TLI) and Lunar Burns (LBN) operation are carried out and the Composite Module will enter Moon's orbit of 100 x 100 km.

The landing site for the Chandrayaan-2 Lander has been selected based on various criteria and from extensive study of the lunar images available from Chandrayaan-1 and Lunar Reconnaissance Orbiter (LRO) spacecrafts. The mission goal of the Lander is to demonstrate a precise, Safe & Soft landing at the identified site. At a predefined time, the Lander separates from the Orbiter and performs a de-boost manoeuvre to reach 18km. At this point all the liquid engines (4 x 800N) and 8 nos. of 50N AOCS Thrusters will fire to brake the velocity from ~1.7 km /sec to ~ 200m /sec so as to reach an altitude of 7 km. It is at this phase that the lander needs to determine its horizontal & vertical velocity and position with respect to the identified landing site. Once the current position and velocity of the Lander w.r.t. the landing site has been ascertained, the Navigation, Guidance and Control (NGC) system on the Lander corrects its trajectory to land precisely at the landing site. The LSPT plan has been worked out in detail to evaluate the performance of all these sensors by carrying out sorties at different heights (0.5 – 7 km) to validate the sensors that provide height information, changing the aircraft speed to verify the velocities computed by the sensors and flying over craters to image and evaluate the pattern matching algorithms used in processing LDPC images.

Many new sensors have been developed to assist the lander in identifying its current position, attitude and velocity, etc. The performance of all these newly developed sensors are evaluated in Lander Sensors Performance Test (LSPT). In addition, a number of other tests for the other new developments like Actuators, NGC and Rover are planned in Lander Propulsion **S**ystem **D**emonstration **M**odel (SDM), **L**ander **A**ctuator **P**erformance **T**est (LAPT), Rover mobility test etc to validate all the new and advance technologies that are very crucial for a safe and soft landing on the lunar landing site and further mobility of the Rover.

This article provides the details of the LSPT being carried out (Fig 1).The first phase of the LSPT was carried out during the last week of October 2016 and the second phase was carried out in March 2017.

LSPT module comprises of Sensors & Supporting systems such as structure, power distribution unit, GPS receiver, SSR etc. (Figure-2). Engineering model of the sensors were used in the LSPT. The NGC software was simulated using an industrial PC. The sensors used in LSPT and their functions are given in table below:

Sl. No.	Sensor	Output Parameters
1	LIRAP (LASER Inertial Reference and Accelerometer Package)	Incremental Velocity, Incremental angle and Inertial Solution
2	KaRA (Ka-band Radio Altimeter)	Altitude, Vertical Velocity
3	LPDC (Lander Position Detection Camera)	Frame centre latitude / longitude upon matching
4	LASA (LASER Altimeter)	Slant Range
5	LHVC (Lander Horizontal Velocity Camera)	Horizontal Velocity

The module was mounted inside the aircraft. The aircraft chosen to conduct this test was NRSC's Super King Air B-200 aircraft with the following specifications:

- Ceiling : 8.8 km (29000 ft) AMSL
- Max Cruise Speed : 120 m/s
- Endurance : 4hr and diversion reserves

The sensors were positioned on the LSPT module to achieve their FOV requirements while viewing through the aircraft optical flat. During the lander's descent to the moon's surface, the LPDC will image the lunar surface and match the images w.r.t the reference craters stored on-board the lander. This phase in the actual lunar descent is simulated by flying the aircraft over a specially prepared site at Chitradurga District, Karnataka where the scaled down artificial craters have been created (fig 3 & 4).

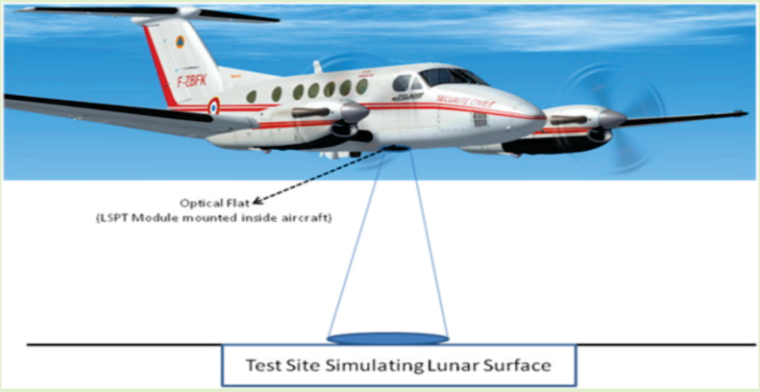

F-ZBFK
Optical Flat
(LSPT Module mounted inside aircraft)
Test Site Simulating Lunar Surface

Fig:1 Pictorial view of LSPT

A number of sorties were carried out as a part of LSPT Phase-1 tests at various altitudes between 0.5 km to 7 km. All the sensors on LSPT were tested and their data was acquired for post processing. The results revealed satisfactory performance of the sensors.

In order to improve the accuracy, further activities such as increasing the crater density and size of craters, autonomous level correction of LIRAP, re-sequencing of initialisation activities to minimise LIRAP initialisation errors etc. were carried out before LSPT Phase-2 Tests. The Phase-2 tests were conducted with additional two sensors namely LASA and LHVC.

Planning and executing LSPT posed many challenges- Identifying a suitable area for creating the craters, obtaining clearance from govt agencies to conduct the sorties and acquire images over the craters and airstrip, excavating the land and creating craters of 18m dia and 4.5m depth, selecting cloud free days and carrying out sorties in the early morning hours so that this test can simulate the illumination conditions that will exist on the lunar surface on the landing day, carrying out LIRAP alignment activities for uploading initial states, azimuth, level etc to reduce propagation errors in the navigation solution, etc.

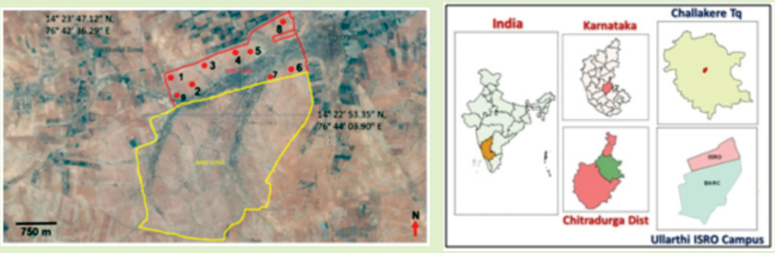


Fig:3 Artificial Lunar Crater location at Chitradurga District, Karnataka

Detailed analysis and review of the LSPT results shows that the performance of the sensors are as per specifications and meet the mission requirements. LSPT Phase-1& 2 was a milestone achieved for the Chandrayaan-2 project. The LSPT Phase-3 is also planned shortly including Laser Doppler Velocimeter(LDV) sensor as well as incremental changes to improve the performance of the sensors which were evaluated during previous phases.

Fig:4

M. VANITHA, APD-Chandrayaan-2

DR. AMBEDKAR JAYANTHI CELEBRATION

Dr. Siddalingaiah with Director ISAC on dias

STATE-OF-THE-ART REAL TIME 3-D X-RAY IMAGING SYSTEM - INAUGURATED BY DIRECTOR, ISAC

The consistent efforts of Components Quality Assurance Division (CQAD) to assure Reliability and Quality of on-board EEE parts gained another milestone on June 1, 2017 when Director ISAC inaugurated the state-of-the-art real time 3-D X-ray system at Failure Analysis Lab. With the commissioning of this system, CQAD has significantly expanded the capability for systematic examination of gold bond wire quality, attachment voids, lid seal and conductive foreign particles inside the hermetically sealed packages. On this occasion, Shri V.Venkatesh, Group Director CMIG, brought out the multiple advanced applications that this system will cater to such as monitoring the registration of drilled holes to internal pads of PCBs, inspecting quality of hidden solder bond of surface mounted components, etc. The unique 3-D imaging capability of this system provides high resolution, high magnification 3-D models of test specimens which can be analyzed in any plane without actually cutting the test specimen. The operationalization of this real time X-ray system has given an edge to failure investigation due to mechanical deformation in relays, conductive loose particles in HMCs, voids in die attach areas, air trap in solder attach areas and inter layer short within PCBs, etc and strengthened the EEE components quality assurance capabilities at CQAD.

Director ISAC also reviewed the EEE Components Quality Assurance Practices by visiting the Spacecraft EEE Components Lab in INSAT building. Smt. Sandhya V. Kamat, Head CQAD presented a comprehensive view of the systematic and well-proven methodology followed at CQAD to ensure the flightworthiness of components and to establish their long term reliability. To this effect, the various activities carried out at Spacecraft EEE Components Lab such as Incoming Inspection, Screening/Up-Screening, Relifing and LAT/VOQ Testing of all active, passive and RF components was presented in detail. Director ISAC took stock of the stringent electrical, mechanical, environmental and assembly related tests that are carried out exhaustively to ensure that the EEE components delivered to the project teams are of the highest available quality. Towards this, the details of advanced infrastructure established by CQAD for mechanical and environmental tests such as Centrifuge Tester, PIND tester, Leak tester and Burn-In chambers were presented. The state-of-the-art EEE components electrical characterization facility consisting of VLSI Tester, UNIMET Tester, EPRO Tester, TESEC semiconductor tester, PXI Tester and Mixed Signal Tester housed at this Lab was well appreciated.

Director ISAC lauded the continuous efforts of CQAD in streamlining the component lifecycle from pre-procurement activities to card fabrication through stringent R&QA measures. He was of the view that the commissioning of real time 3-D X-Ray Imaging System at ISAC along with the existing EEE Components Quality Assurance Facility would go a long way in strengthening ISAC's Zero Defect Delivery programme.

V. Venkatesh, Group Director, CMIG

25 YEARS SERVICE COMPLETION - FELICITATION

Inauguration of New VIP Dining Lounge by Chairman, ISRO

Inauguration of Additive Manufacturing Facility by Director, ISAC

Thermoplastics Additive Manufacturing
Metal Additive Manufacturin

Demonstration of New Deployment Mechanism (DEMO Model) to Chairman, ISRO

Visit of FICCI Ladies Organisation Team

INDIAN ARMY TEAM VISIT

NATIONAL SAFETY DAY - 2017

BHUTAN DELEGATION VISIT TO ISAC

BHOOMI POOJA-DYNAMIC TEST FACILITY AT ISAC

INAUGURATION OF REVERSE OSMOSIS FACILITY AT ISAC

KAZAKHSTAN DELEGATION VISIT

THAILAND DELEGATION VISIT TO ISAC

Visit of Portugal Delegation to ISITE

Visit of Bolivian Delegation to ISITE

French Delegation Visit to ISAC

INTERNATIONAL DAY OF YOGA 2017

International Day of Yoga – 2017 was celebrated in ISAC with a two-week long Yoga Fortnight, which started from 7th June 2017. Meditation classes were arranged from 7th June. These classes were conducted by Mr. Ujwal Shankar of Art of Living. More than 538 employees attended these meditation classes.

From 12th June, practice sessions for the 'Common Yoga Protocol', recommended by Dept. of AYUSH were arranged. Mr. Gopalakrishna Hegde and Ms. Seema Venugopal, Yoga Teachers from Shree Yoga Vijnana Kendra, conducted these classes from 12th to 20th June 2017. Nearly 300 employees actively participated in the practice sessions.

Yoga based competitions like Yogasana Demonstration, Surya Namaskara and Yoga Quiz, were also arranged. Many employees took part in these competitions with lot of zeal and interest.

On the International Day of Yoga (21st June 2017), 'Common Yoga Protocol' was practiced between 7.00AM to 8.00 AM. About 350 enthusiastic ISACians attended this event.

A Guest Lecture on "Yoga for Holistic Health" by Yogaratna Dr. SN Omkar of IISc, was arranged at Satish Dhawan Auditorium. Dr. SN Omkar, in his talk emphasized on the Yogic way of living and also demonstrated a few Surya Namaskar practices.

In the afternoon, as a part of Yoga fest, cultural programme with Yoga based Dance and Music was organized. Team from Art of Living Foundation & students of Kendriya Vidyalaya, NAL Campus, gave a stunning performance and entertained the audience. Nearly 400 employees attended this event.

Dr. M Nageswara Rao, Associate Director, ISAC, on the International Day of Yoga, in his opening remarks highlighted the importance & benefits of Yoga and suggested employees to practice yoga regularly. Sri GNV Prasad, Dy Director, MISA gave brief account of the Gym Hall, which is coming up at ISAC for the benefit of staff. Sri Shivaprakash B, Convener, Organising Committee thanked the management & employees for the excellent support & cooperation in successful conduct of the events of Yoga Fortnight and Yoga Day celebrations.

SATELLITE TECHNOLOGY DAY -2017

Nineteenth of April 1975 is a historic day for the Indian Space Programme. On this day, India's first satellite 'Aryabhata' was launched successfully, which has spear headed the growth of satellite technologies. To commemorate this event, 19th of April, every year is being celebrated as Technology Day, since the year 2000, showcasing the various achievements made in the area of satellite technology.

This year the Aryabhata Lecture was delivered by the distinguished chief guest, Ms. Kiran Mazumdar Shaw, Chairman & Managing Director of Biocon Limited, Bengaluru.

TECHNICAL PAPER PRESENTATIONS:

A call for papers was issued to all ISRO centers in seven categories stressing novelty, demonstrated results - on-orbit and/or on ground - new design concepts, theoretical modeling and analysis, new process/product development and applications, new materials and their scope in spacecraft systems, new methods of test, evaluation and characterization, spacecraft ground systems development and standardization of spacecraft systems for production and automation. There was a highly enthusiastic response from the ISRO community to this call and sixty-nine papers were received. Rigorous evaluations of the papers were carried out by meticulously selected domain experts. Nine outstanding papers were selected for presentation during the Satellite Technology Day - 2017 symposium. The selected papers bring out the designs and developments being realized in different areas of spacecraft technology. The Proceedings of Satellite Technology Day - 2017 include the abstract of the Aryabhata lecture and full texts of all the nine selected papers were released. The authors were also awarded with a memento and a certificate.

SPARK - PLATFORM FOR INNOVATIVE IDEAS:

In an effort to spur innovation and provide young engineers a platform to express their innovative ideas, a new event SPARK has been initiated as part of the Satellite Technology Day activity. The idea behind SPARK is that young, enthusiastic engineers with inter-disciplinary skills will form a team under the guidance of an experienced mentor, propose novel and innovative ideas / research proposals that can be developed for future (typically 10 to15-year timescale) use in the areas of Satellite related technology (onboard systems, ground systems / operations, manufacturing / production, processes, materials, etc.), space based applications and space based science explorations

The response to SPARK was excellent. The topics were innovative and many new proposals and ideas were put across by the young engineers. The proposals showed the sincere efforts put by youngsters. Thirty-eight proposals were received covering all most all fields of satellite technology & applications. Based on criteria detailed in the call letter, nineteen abstracts were selected for review.Primacy was given for concept, originality and feasibility. Three reviewers were chosen from relevant fields per abstract and based on the feedback from reviewers eight abstracts were chosen for final presentation and another ten for poster presentation. All the eight presentations were judged by a panel of judges and three prizes awarded. Parallelly, all the authors of the poster presentation were awarded a certificate. This year about thirty posters from all the groups and facilities of ISAC were displayed and the best poster was awarded a rolling trophy.

Regardless of the fate of the proposal at SPARK, we strongly urge the teams to pursue their ideas and continue work in these frontier areas of Satellite Technology and its applications.

Organising Committee, STD-2017

EEE COMPONENTS FOR SPACE APPLICATIONS (EEE CONF-2017)

Conference on "EEE Components for Space Applications (EEE Conf-2017)" was organized at ISRO Satellite Centre (ISAC) on 25th April 2017. ISRO is primarily responsible for implementation of Space systems and harnessing its usage for national needs. Electrical, Electronics and Electro-mechanical (EEE) components are the building blocks of all the electronic systems including launch vehicles, satellites, payloads etc. They enable the development of high-performance and high-reliability systems which are of utmost importance to ISRO programmes.

The conference aimed at assimilation & dissemination of information & wisdom by reviewing state of the art & state of the practice scenario, ongoing and future trends, locally & globally changing patterns in the area of EEE Components. Industry, academia and R&D institutions of national importance across the country including DRDO, DAE responded overwhelmingly. About 140 delegates participated from these sources to join 300 more delegates from various centers of ISRO. Key-note address followed 4 technical sessions, a panel discussion and a poster session. Ten invited talks and ten contributed papers (out of 53 full length papers received) were presented.

Dr. M Ravindra, DD, RQA and Chairman of Organising Committee welcomed all and presented the overview of the conference. He outlined the aim of the conference and encouraged deliberations on technological advancements, replacement of the older technologies, need for adaptation of novel test and engineering methods advent of COTS, indigenous realisation of components etc. Dr. M Annadurai, Director, ISAC, in his address, emphasized on the importance of timely availability of high-reliability EEE components for spacecraft realization by the centre. He also mentioned the efforts taken to adapt the best practices in the EEE components field and encouraged Indian industries to take up indigenization activities so as to establish a self reliant system. In his keynote address titled "Nanotechnology & internet of things", Prof. V Ramgopal Rao, Director of IIT Delhi gave motivating examples of how research is transformed into applications for the country. He stressed that quality EEE Components are also needed for development of high performing sensors. A compendium of EEE Conf-2017 containing messages, abstracts of presentations and full length papers was released on the occasion. Inaugural function got concluded with vote of thanks.

In technical sessions that ran parallel, heads of reliability entities at VSSC, ISAC, SAC, SCL, LEOS, ISRO HQ gave invited talks touching upon the practices followed, challenges faced and initiatives taken-up for meeting supply of reliable EEE parts. Experts from industries (including Centum, Dalmia) and academic institutions (IISc, Veltech University, Jain Univrsity) joined them to complement the perspectives. Presentations were also made from institutions of national importance viz. BHEL, ARCI, IGCAR etc. Contributed papers were focused various aspects of EEE components in manufacturing, screening, inventory management, COTS, packaging approaches, obsolescence, weeding counterfeits, etc. Senior DDs and GDs of ISAC presided over the sessions as chair and co-chair.

Panel discussion on "EEE Components - Advances and Challenges" witnessed enthusiastic participation of the audience. Various questions related to sourcing, screening, alternates, COTS, indigenization, material availability etc. were discussed. Few initiatives and approaches were found & chosen for perusal.

The conference met its objectives and was very well appreciated by the participants, speakers, panelists, chair and co-chairs.

Organizing Committee, EEEConf-2017

ISAC SAFETY DAY – 2017

The Government of India has designated March 4 every year as the National Safety Day in commemoration of the establishment of the National Safety Council. Since 1972 this day is celebrated as National Safety Day throughout the country to reiterate the importance of safety and create an awareness campaign aimed at renewing the commitment of employees and general public to work safely throughout the year. The ultimate objective of the Campaign is to ensure integration of Occupational Safety and Health (OSH) in work culture and life style.The theme for the year is **"LEADERSHIP IN SAFETY AND HEALTH ENHANCES BUSINESS SUSTAINABILITY"**

NATIONAL SAFETY DAY CELEBRATION AT ISAC

The safety & Security Division (SSD) /PPEG has been observing Safety Day at ISAC with thematic programmes to spread safety awareness.

As is the past, five competitionswere organized, namely:

1. Essay writing Competition (Topic: "Safety and Health as tool for Growth and sustainability") in Hindi, English, Kannada
2. Pick and Speak (Hindi, English, Kannada)
3. Safety Awareness Aptitude Test (SAWAT)
4. Poster making competition
5. Slogan Writing Competition

Around 150 young ISACians participated in these competitions

The Valedictory of the ISAC Safety Day – 2017 was held at SatishDhawan Auditorium on April 6, 2017

Shri. A. Rajendra, Head, AMPS/TSG/ Chairman, Safety Day Organizing Committee, welcomed the gathering. Dr Nitin S Deshpande, Innovation Manager/ SH & E coordinator from Hindustan Unilever R&D, Bangalore was the chief guest on this occasion. He delivered a very informative talk on the topic "Best Safety Practices – Radiation, Chemical & Gas Safety"

Dr. M. Annadurai, Director, ISAC presided over the function. In his address he outlined the importance of safety in our activities. Shri. P Aravindakshan, Chairman, ISAC Safety Committee gave a detailed account of the activities of Safety & Security Division (SSD). Shri G N V Prasad, GD/PPEG in his speech touched upon the future plans of SSD. Shri Santhosh Hebbar P, Head, SSD administered the safety pledge.

At the end of the function, the prizes were distributed to the winners of the various competitions. A display of the fire fighting equipment and accessories was also arranged during the occasion. Videos on Safety were also screened.

'FINANCE AND ACCOUNTS SCANNER' AND 'READY RECKONER FOR ACCOUNTS OFFICER'S PRACTICAL EXAM' - BOOK RELEASE

FINANCE & ACCOUNTS SCANNER
Satya, Sr. IFA, ISAC
READY RECKONER FOR ACCOUNTS OFFICER'S PRACTICAL EXAM
Satya, Sr. IFA, ISAC
AVF/ISAC

The books 'Finance and Accounts Scanner' and 'Ready Reckoner for Accounts Officer's Practical Exam' authored by Shri. P. Sathyanarayana, Senior Head Accountsand IFA was released by Prof. U. R. Rao at ISAC on 10th March 2017, during his felicitation function on receiving the Padma Vibhushan, in the august presence of Director, Controller and the senior executives of ISAC.

F & A Scanner comprehensively covers the topics on Budget, Receipts and Payment Rules, Civil Accounts Manual, TA, LTC, Pension, Civil Works and Purchase Manual. Ready Reckoner serves as a mandatory reference manual for officials to prepare for the feeder cadre Accounts Officer's Examination. Both the books are compendium of information on finance and accounts rules presented lucidly with precision. It is used as a reference book for training staff and officers on the said topics.

HRD TRAINING & DEVELOPMENT PROGRAMS DURING APRIL-JUNE 2017

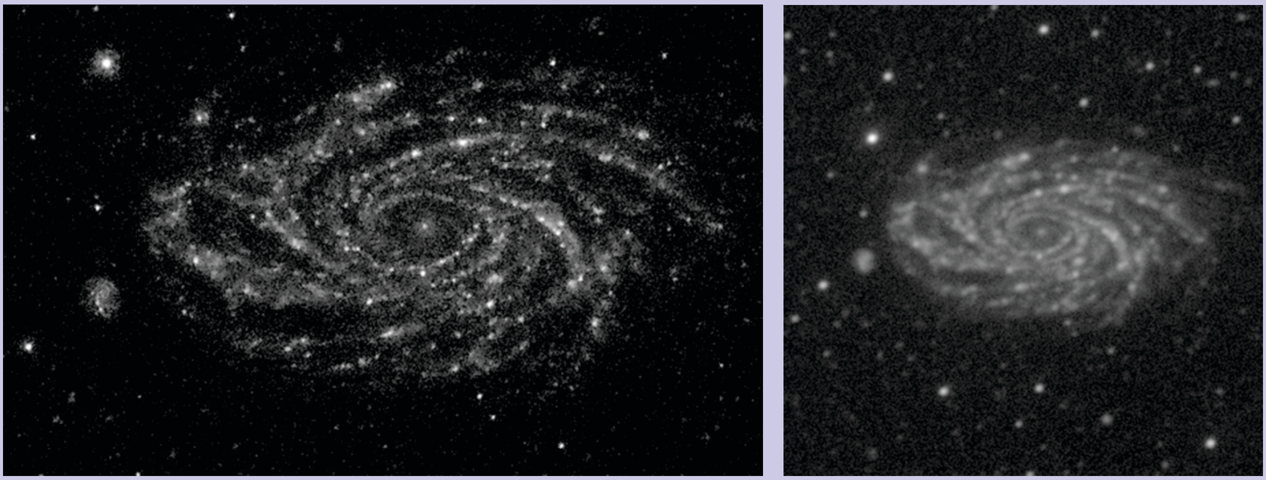
Sl. No.	Training	Target Participants	Duration	No. of Participants
1.	Advanced MS-Excel and Macros with VBA	ISAC and LEOS Employees	April 12-13,17-18, 2017	14
2.	Specialized Workshop on "Control Systems for Space Applications"	Sci./Engr. From ISAC, LEOS and ISTRAC	April 17 -19, 2017	52
3.	"Mandatory Training Programme (Electronics) at ISAC for Junior Engineers for the post of "Assistant Engineer"	Junior Engineers	April 24-May 19, 2017	26
4.	Self Development Programme Through Lifestyle Enhancement	Junior Engineers & Senior Technicians	April 27 -29, 2017	18
5.	Refresher Training Programme for Technicians (Electronics)	Technicians and Senior Technicians	May 23 – 30, 2017	33
6.	Self Development Programme Through Lifestyle Enhancement	Assistants	May 25 -27, 2017	33
7.	Specialized Training on Red Hat Enterprise Linux (RHEL)-7 SE Linux	Sci./Engrs. of CIG and PPEG	May 30 – June 2, 2017	16
8.	Linux Training Programme on Python	ISAC & LEOS Employees	June 13- 15, 2017	16
9.	Managerial Skills Development Programme	Sci./Engr. –SE from ISAC and LEOS	June 28 - July 1, 2017	(30)
10.	Familiarization Programme for IIST Students – Internship	IIST Students	June 5 - July 14, 2017	26
11.	International Yoga Day Celebration	ISAC Employees	June 7 -21, 2017	

ಆಸ್ಟ್ರೋಸ್ಯಾಟ್ ವೀಕ್ಷಣಾಲಯದಲ್ಲಿನ ಅತಿನೇರಳೆ ದೂರದರ್ಶಕ.

ನಮಗೆಲ್ಲಾ ತಿಳಿದಿರುವಂತೆ, ಕೇಂದ್ರಭಾಗದಲ್ಲಿ ಜಲಜನಕವನ್ನು ಉರಿಸಿ ತನ್ಮೂಲಕ ಬೆಳಕನ್ನು ಸೂಸುವ ತಾರೆಗಳು ಮುಖ್ಯವಾಹಿನಿಯನ್ನು (Main sequence) ಆವರಿಸುತ್ತವೆ. ಈ ಮುಖ್ಯ ವಾಹಿನಿಯ ತಾರೆಗಳ ಪ್ರಕಾಶವು ತಾರೆಯ ದ್ರವ್ಯರಾಶಿಯ ಮೇಲೆ ಮುಖ್ಯವಾಗಿ ಅವಲಂಬಿಸಿರುತ್ತದೆ. ಆದರೆ, ಕೆಲವು ತಾರೆಗಳು ತಮ್ಮದೇ ದ್ರವ್ಯರಾಶಿ ಹೊಂದಿರುವ ಮುಖ್ಯವಾಹಿನಿಯ ತಾರೆಗಳ ಪ್ರಕಾಶಮಾನತೆಗಿಂತಲೂ (magnitude) 2-3 ಪ್ರಕಾಶಮಾನತೆಗಳಷ್ಟು ಕಡಿಮೆ ಪ್ರಮಾಣದಲ್ಲಿ ಬೆಳಕು ಸೂಸುವುದು ಕಂಡುಬಂದಿತ್ತು. ಪ್ರಕಾಶಮಾನತೆಯ ನಕಾಶೆಯಲ್ಲಿ ಮುಖ್ಯವಾಹಿನಿಗಿಂತಲೂ ಕೆಳಭಾಗದಲ್ಲಿ ನೆಲೆಸಿರುವ ಈ ತಾರೆಗಳನ್ನು ಉಪಕುಬ್ಜ (subdwarf) ಎಂದು ಕರೆಯಲಾಗುತ್ತದೆ. ಅಂತಹ ಒಂದು ಉಪಕುಬ್ಜವು 1995ರಲ್ಲಿ NGC-188ರಲ್ಲಿ ಕಂಡುಹಿಡಿಯಲ್ಪಟ್ಟಿತ್ತು. ಕೆಂಪನೆಯ ಕಿರಣಗಳಲ್ಲಿ ಮುಖ್ಯವಾಗಿ ಪ್ರಕಾಶಿಸುತ್ತಿದ್ದರಿಂದಾಗಿ ಆ ತಾರೆಯು ನಮ್ಮ ಸೂರ್ಯನಿಗಿಂತಲೂ ಕಡಿಮೆ ತಾಪದ ತಾರೆಯೆಂದು ಗುರುತಿಸಲ್ಪಟ್ಟರೂ, ಈ ತಾರೆಯು ಅತಿನೇರಳೆ ಕಿರಣಗಳಲ್ಲಿ (UV) ಹೆಚ್ಚು ಪ್ರಕಾಶಮಾನವಾಗಿ ಕಂಡುಬಂದದ್ದರಿಂದಾಗಿ, ಅದು ಒಂದು ಹೆಚ್ಚಿನ ತಾಪದ ತಾರೆಯೂ ಸಹ. ಹೀಗಾಗಿ ಅಂದಿನಿಂದಲೇ ಈ ತಾರೆಯು ಏಕಕಾಲದಲ್ಲಿ ಒಂದು ತಂಪಾದ ಮತ್ತು ಹೆಚ್ಚು ತಾಪದ ತಾರೆಯಾಗಿ ಖಗೋಳಶಾಸ್ತ್ರಜ್ಞರಿಗೆ ಸುಮಾರು ಎರಡು ದಶಕಗಳ ಕಾಲ ಒಗಟಾಗಿ ಉಳಿದಿತ್ತು. ಸೆಪ್ಟಂಬರ್ 28, 2015ರಲ್ಲಿ ಹಾರಿಸಲ್ಪಟ್ಟ ಭಾರತದ ಪ್ರಪ್ರಥಮ ಖಗೋಳವಿಜ್ಞಾನ ವೀಕ್ಷಣಾಲಯ ಆಸ್ಟ್ರೋಸ್ಯಾಟ್ ಈ ತಾರೆಯನ್ನು ವೀಕ್ಷಿಸುವವರೆಗೂ ಈ ಒಗಟು ಒಂದು ಒಗಟಾಗಿಯೇ ಉಳಿದಿತ್ತು. ಈ ಎರಡು ದಶಕಗಳ ನಿಗೂಢತೆಯನ್ನು ಭೇಧಿಸಿದ್ದು ನಮ್ಮ ಆಸ್ಟ್ರೋಸ್ಯಾಟ್ ವೀಕ್ಷಣಾಲಯದಲ್ಲಿನ ಅತಿನೇರಳೆ ದೂರದರ್ಶಕ, UVIT (Ultra-Violet Imaging Telescope).

ಈಗಾಗಲೇ ತಿಳಿದಂತೆ, UVIT ಆಸ್ಟ್ರೋಸ್ಯಾಟ್ ವೀಕ್ಷಣಾಲಯದಲ್ಲಿನ ಒಟ್ಟು ಐದು ಪಾವತಿಹೊರೆಗಳಲ್ಲಿ (payload) ಒಂದು. UVIT 40 ಸೆಂ.ಮೀ. ತ್ರಿಜ್ಯದ ಎರಡು ದೂರದರ್ಶಕಗಳ ಮೂಲಕ ಮೂರು ಆವರ್ತನಶ್ರೇಣಿಗಳಲ್ಲಿ (bandwidth) ಆಕಾಶಕಾಯಗಳ ಅಧ್ಯಯನ ನಡೆಸುತ್ತದೆ: ದೂರದ ಅತಿನೇರಳೆ ಕಿರಣಗಳು (FUV), ಹತ್ತಿರದ ಅತಿನೇರಳೆ ಕಿರಣಗಳು (NUV) ಮತ್ತು ದೃಗ್ಗೋಚರ (VIS). ಈ ದೂರದರ್ಶಕದ ಎರಡೂ ಮಸೂರಗಳನ್ನು ಇಸ್ರೋದ ಲಿಯೋಸ್ (LEOS) ಕೇಂದ್ರದಲ್ಲಿ ತಯಾರಿಸಿಲಾಗಿದೆ ಮತ್ತು ಕ್ಯಾಮೆರಗಳನ್ನು ಕೆನಡಾದ ಕೆನೆಡಿಯನ್ ಸ್ಪೇಸ್ ಏಜೆನ್ಸಿ (CSA) ತಯಾರಿಸಿದೆ.

ಅಸ್ಟ್ರೋಸ್ಯಾಟ್-ನಲ್ಲಿನ UVIT ದೂರದರ್ಶಕವು ಮೂರು ಆವರ್ತನಶ್ರೇಣಿಗಳಲ್ಲಿ ಒಂದೇ ಸಮಯದಲ್ಲಿ ಅಧ್ಯಯನ ಮಾಡಬಹುದಾದರೂ, ಈ ಮೂರು ಕ್ಯಾಮೆರಗಳು ರಚನೆಯಲ್ಲಿ ಒಂದೇ ತರಹದ್ದು. ಈ ಕ್ಯಾಮೆರಗಳ ಮುಂದಿರುವ ದ್ಯುತಿವಿದ್ಯುತ್ ವಸ್ತುವಿನ ಮೇಲಿನ ಪದರವು ಆರಿಸಿದ ಆವರ್ತನಶ್ರೇಣಿಗಳಲ್ಲಿ ಕೆಲಸ ಮಾಡುವ ಮುಖಾಂತರ ಆಯಾ ಆವರ್ತನಶ್ರೇಣಿಗಳಲ್ಲಿನ ಚಿತ್ರವನ್ನು ತೆಗೆಯಲು ಅನುವು ಮಾಡಿಕೊಡುತ್ತವೆ. ಅತಿ ನೇರಳೆ ಕಿರಣವು ಈ ದ್ಯುತಿವಿದ್ಯುತ್ ವಸ್ತುವಿನ ಮೇಲೆ ಬಿದ್ದಾಗ ಇಲೆಕ್ಟ್ರಾನುಗಳನ್ನು ಬಿಡುಗಡೆ ಮಾಡುತ್ತದೆ. ಈ ಇಲೆಕ್ಟ್ರಾನುಗಳು ಸೂಕ್ಷ್ಮಗತಿಗಳಲ್ಲಿ ಪ್ರವಹಿಸುವಂತೆ ಮಾಡುವ ಮೂಲಕ ಅವುಗಳ ಸಂಖ್ಯೆಯನ್ನು ಪ್ರವರ್ಧಿಸಲಾಗುತ್ತದೆ ಮತ್ತು ಕೊನೆಯಲ್ಲಿ ಈ ಇಲೆಕ್ಟ್ರಾನುಗಳು ಮತ್ತೊಮ್ಮೆ ದ್ಯುತಿವಿದ್ಯುಜ್ಜನಕದ ಮೇಲೆ ಬಿದ್ದು ದೃಗ್ಗೋಚರ ಕಿರಣಗಳಾಗಿ ಪರಿವರ್ತನೆಗೊಂಡು ಕ್ಯಾಮೆರಾದಲ್ಲಿ ಬಂಧಿಯಾಗುತ್ತವೆ. ಹೀಗೆ ತಮ್ಮ ಮೇಲೆ ಬಿದ್ದ ಪ್ರತಿಯೊಂದು ಕಿರಣವು ಹಲವಾರು ಇಲೆಕ್ಟ್ರಾನುಗಳಾಗಿ ಪ್ರವರ್ಧಿಸುವುದರಿಂದಾಗಿ, ನಾವು ಪ್ರತಿಯೊಂದು ಕಿರಣವನ್ನು ಸಹ ಅವು ಯಾವ ಸ್ಥಳದಲ್ಲಿ ಬಿದ್ದಿತು ಮತ್ತು ಯಾವ ಸಮಯದಲ್ಲಿ ಬಿದ್ದಿತೆಂಬುದನ್ನು ಕಂಡುಹಿಡಿಯಬಹುದು.



ಚಿತ್ರ 1: UVIT ದೂರದರ್ಶಕದಿಂದ ತೆಗೆಯಲ್ಪಟ್ಟ NGC 2336 ಚಿತ್ರ. ಹೋಲಿಕೆಗಾಗಿ GALEX ವೀಕ್ಷಣಾಲಯದಿಂದ ತೆಗೆದ ಚಿತ್ರವನ್ನು ಬಲಭಾಗದಲ್ಲಿ ತೋರಿಸಲಾಗಿದೆ.

ಮಾಲಿನ್ಯವು ಅತಿನೇರಳೆ ಕಿರಣಗಳ ವೀಕ್ಷಣೆಯ ಒಂದು ದೊಡ್ಡ ಶತ್ರು, ಎಷ್ಟೆಂದರೆ, ಮಸೂರದ ಮೇಲಿನ ಕೇವಲ ಒಂದು ಅಣ್ವಿಕ ಪದರ (single molecular layer) UVITಯ ಸಂವೇದನೆಯನ್ನು ಸುಮಾರು 10-20% ಕಡಿಮೆ ಮಾಡಬಲ್ಲದು. ಹೀಗಾಗಿ UVIT ದೂರದರ್ಶಕದ ತಯಾರಿಕೆಯ ಎಲ್ಲ ಹಂತಗಳಲ್ಲೂ ಮತ್ತು ಉಡಾವಣೆಯ ಮೊದಲು ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣವು ಅತ್ಯಂತ ಕಠಿಣ ಮತ್ತು ಮಹತ್ವದ ವಿಷಯವಾಗಿತ್ತು. ಇಂತಹದೇ ಹಲವಾರು ಅತ್ಯಂತ ಕಠಿಣ ಪರಿಶ್ರಮಗಳಿಂದ ಲಿಯೋಸ್, ಐಯುಕಾ, ಸಿ ಎಸ್ ಎ ಮತ್ತು ಇಸ್ರೋ ಉಪಗ್ರಹ ಕೇಂದ್ರಗಳ ಸಹಕಾರದೊಂದಿಗೆ ಭಾರತೀಯ ಖಗೋಳ ವಿಜ್ಞಾನ ಕೇಂದ್ರದಲ್ಲಿ ಅಭಿವೃದ್ಧಿಗೊಳಿಸಲ್ಪಟ್ಟ UVIT ಇಂದು ಪ್ರಪಂಚದಲ್ಲಿಯೇ ಅತ್ಯಂತ ಸ್ಫುಟವಾದ ವೈಜ್ಞಾನಿಕ ಚಿತ್ರಗಳನ್ನು ಕೊಡುವ ಮೂಲಕ ಈಗಾಗಲೇ ಹಲವಾರು ವೈಜ್ಞಾನಿಕ ಕೊಡುಗೆಗಳನ್ನು ಕೊಡಲು ಪ್ರಾರಂಭಿಸಿದೆ ಮತ್ತು ಇನ್ನು ಮುಂದೆಯೂ ಈ ದೂರದರ್ಶಕದಿಂದ ಹಲವಾರು ಹೊಸ ವಿಷಯಗಳು ದೊರಕಲಿವೆ ಎಂಬುದರಲ್ಲಿ ಸಂಶಯವಿಲ್ಲ. ನಮ್ಮ UVITಯಿಂದ ಇದುವರೆವಿಗೂ ಬಂದ ಫಲಿತಾಂಶಗಳಲ್ಲಿ ಎರಡು ಫಲಿತಾಂಶಗಳನ್ನು ಮಾತ್ರ ಇಲ್ಲಿ ಕೊಡಲಾಗಿದೆ.

ಈ ಮೊದಲಿಗೆ ಹೇಳಿದ NGC 188ನಲ್ಲಿನ ಒಂದು ಉಪಕುಬ್ಜವು ಒಂದೇ ಸಮಯದಲ್ಲಿ ಹೆಚ್ಚಿನ ತಾಪ ಮತ್ತು ತಂಪಾಗಿ ಕಾಣಲು ಕಾರಣ ಇದು ಕೇವಲ ಒಂದೇ ತಾರೆಯಲ್ಲ ಬದಲಿಗೆ ಅದು ಒಂದು ಯುಗಳ ತಾರೆ (binary) ಎಂದರೆ, ಇದು ಪರಸ್ಪರ ಗುರುತ್ವಾಕರ್ಷಣೆಗೊಳಗಾಗಿರುವ ಜೋಡಿ ತಾರೆಗಳು.

ಈ ಎರಡರಲ್ಲಿ ಒಂದು ತಂಪಾದ ತಾರೆಯಾದರೆ, ಎರಡನೆಯದು ಹೆಚ್ಚಿನ ತಾಪದ ತಾರೆ. ಈ ಹೆಚ್ಚಿನ ತಾಪದ ಯುಗಳ ತಾರೆಯ ಇರುವಿಕೆ ಪ್ರಪ್ರಥಮ ಭಾರಿಗೆ ಭಾರತೀಯ ವೀಕ್ಷಣಾಲಯ ಆಸ್ಟ್ರೋಸ್ಯಾಟ್-ನ ಮಾಹಿತಿಯಿಂದ ದೊರೆಯಿತೆಂದರೆ UVITಯ ಉಪಯುಕ್ತತೆಯ ಅರಿವಾಗುತ್ತದೆಯಲ್ಲವೇ?

UVIT ಈಗ ಕೆಲಸ ಮಾಡುತ್ತಿರುವ ಯಾವುದೇ ಅತಿನೇರಳೇ ಕಿರಣ ದೂರದರ್ಶಕಕ್ಕಿಂತಲೂ ಹೆಚ್ಚಿನ ಪೃಥಕ್ಕರಣ (resolution) ಹೊಂದಿರುವ ಕಾರಣ UVITಯ ಚಿತ್ರಗಳು ಹೆಚ್ಚು ಸ್ಫುಟವಾಗಿರುವುದರ ಜೊತೆಯಲ್ಲಿಯೇ ಅದು ಹೆಚ್ಚಿನ ವಿವರಗಳನ್ನೂ ಸಹ ಕೊಡುವ ಸಾಮರ್ಥ್ಯವನ್ನು ಹೊಂದಿದೆ. ಉದಾಹರಣೆಗೆ ಚಿತ್ರ 1ರಲ್ಲಿ ತೋರಿಸಿರುವ NGC 2336ಯ UVITನಿಂದ ತೆಗೆಯಲ್ಪಟ್ಟ ಚಿತ್ರ. UVITಯ ಔನತ್ಯವನ್ನು ತೋರಲು ಹೋಲಿಕೆಗಾಗಿ GALEXನಿಂದ ತೆಗೆಯಲ್ಪಟ್ಟ ಚಿತ್ರವನ್ನು ಸಹ ತೋರಲಾಗಿದೆ. ಉದಾಹರಣೆಗೆ NGC 2336ನ ಎಡ ಭಾಗದಲ್ಲಿರುವ ಉಪಗ್ರಹ ನಿಹಾರಿಕೆಯನ್ನು (satellite galaxy) ನೋಡಿ. ಇದು GALEX ಚಿತ್ರದಲ್ಲಿ ಕೇವಲ ಒಂದು ಉಂಡೆಯಂತೆ ಕಂಡುಬಂದರೆ, UVIT ಚಿತ್ರದಲ್ಲಿ ಅದರದೇ ಆದ ಬೇರೆ ಬೇರೆ ಭಾಗಗಳನ್ನು ಹೊಂದಿರುವುದು ಕಂಡುಬರುತ್ತದೆಯಲ್ಲವೇ? ಹಾಗೆಯೇ, ಚಿತ್ರದ ಬಲ ಭಾಗದಲ್ಲಿನ ನಿಹಾರಿಕೆಯ ಬಾಹುಗಳನ್ನು ಗಮನಿಸಿದಾಗ ನಮಗೆ ಬಹಳಷ್ಟು ಹೆಚ್ಚಿನ ವಿವರಗಳು ಸಹ ಕಾಣುವುದಲ್ಲವೇ?

ಅತಿನೇರಳೆ ಕಿರಣದ ದೂರದರ್ಶಕದಂತೆಯೇ ಒಟ್ಟಾರೆ ಆಸ್ಟ್ರೋಸ್ಯಾಟ್ ಸಹ ಇಂತಹದೇ ಹಲವಾರು ರೋಮಾಂಚಕ ವಿಷಯಗಳನ್ನು ಮತ್ತು ಹೊಸ ಹೊಸ ಅವಿಷ್ಕಾರಗಳನ್ನು ಕೊಡಲಿ ಎಂದು ಹಾರೈಸೋಣವಲ್ಲವೇ?

ಡಾ|| ವಿ. ಗಿರೀಶ್
ಬಾಹ್ಯಾಂತರಿಕ್ಷ ಖಗೋಳ ವಿಜ್ಞಾನ ಸಮೂಹ

हिंदी यूनिकोड कंप्यूटर प्रशिक्षण रिपोर्ट

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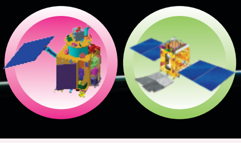
भारत सरकार, राजभाषा विभाग तथा संसदीय राजभाषा समिति के निदेशों के अनुसार, हिंदी के प्रगामी प्रयोग को बढ़ावा देने हेतु केंद्र द्वारा प्रशासनिक क्षेत्र के लिए हिंदी कार्यशाला का आयोजन किया जाता है। इस संबंध में, इसरो उपग्रह केंद्र में दिनांक 17.05.2017 को प्रशासनिक क्षेत्र के सहायकों के लिए हिंदी अनुभाग द्वारा एक हिंदी यूनिकोड कंप्यूटर प्रशिक्षण का आयोजन किया गया। सर्वप्रथम, श्रीमती गीता प्रसाद, हिंदी अधिकारी ने मुख्य अतिथि एवं प्रतिभागियों का स्वागत किया। श्री अशोक कुमार बिल्लूरे, संयुक्त निदेशक (निवृत), अं.वि. ने सत्र का संचालन किया। प्रशिक्षण के दौरान संकाय सदस्य ने बेसिक कंप्यूटर प्रशिक्षण, खास तौर पर हिंदी के साफ्टवेयर के उपयोग के बारे में प्रशिक्षण जानकारी दी तथा राजभाषा के महत्व को बताते हुए राजभाषा के नीति, नियमों एवं अधिनियमों पर प्रकाश डालते हुए विभाग में लागू विभिन्न प्रोत्साहन योजनाओं एवं प्रशिक्षण के बारे में सभी प्रतिभागियों को अवगत कराया और साथ ही उन्होंने **"दैनंदिन कार्य में हिंदी का प्रयोग"** विषय पर व्यावहारिक रूप से प्रशिक्षणार्थियों को विस्तृत ज्ञानवर्धक जानकारी प्रदान की।

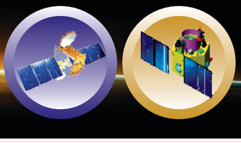
इस कार्यशाला में कुल 28 प्रतिभागियों ने भाग लिया। श्री. मनोहर एल वाणियर, वरिष्ठ प्रधान, कार्मिक व सामान्य प्रशासन ने कार्यशाला के समापन समारोह की अध्यक्षता की। उन्होंने सभी प्रतिभागियों से अपील किया कि अपना दैनंदिन शासकीय कार्य हिंदी में करें और अपने सहकर्मियों के साथ हिंदी में वार्तालाप करें तथा आकस्मिक अवकाश, अर्जित अवकाश, चिकित्सा बिल, भविष्य निधि, अग्रिम आवेदन आदि मुद्रित प्रपत्रों को हिंदी में भरें।कार्यशाला के अंत में श्री. शारिख़, व. सहायक ने सभी का आभार प्रकट किया।

हिंदी कार्यशाला रिपोर्ट

भारत सरकार, राजभाषा विभाग तथा संसदीय राजभाषा समिति के निदेशों के अनुसार, हिंदी के प्रगामी प्रयोग को बढ़ावा देने हेतु केंद्र द्वारा हर तिमाही में अधिकारी/कर्मचारियों के लिए हिंदी कार्यशाला का आयोजन किया जाता है। इसी श्रृंखला में, इसरो उपग्रह केंद्र द्वारा दिनांक 14 व 15 जून 2017 को वाहन चालक कर्मचारियों के लिए हिंदी अनुभाग द्वारा एक हिंदी कार्यशाला का आयोजन किया गया। सर्वप्रथम, श्री. शारिख, वरिष्ठ सहायक ने हिंदी अधिकारी एवं प्रतिभागियों का स्वागत किया। दिनांक 14.06.2017 को श्रीमती हेमा बी. के., हिंदी अधिकारी, इस्ट्रैक, बेंगलूरु तथा दिनांक 15.06.2017 को श्रीमती गीता प्रसाद, हिंदी अधिकारी, आईज़ेक ने सत्र का संचालन किया। कार्यशाला के दौरान संकाय सदस्य ने राजभाषा के महत्व को बताते हुए राजभाषा के नीति, नियमों एवं अधिनियमों पर प्रकाश डालते हुए विभाग में लागू विभिन्न प्रोत्साहन योजनाओं एवं प्रशिक्षण के बारे में सभी प्रतिभागियों को अवगत कराया और साथ ही उन्होंने **"दैनंदिन कार्य में हिंदी का प्रयोग"** विषय पर व्यावहारिक रूप से प्रशिक्षणार्थियों को विस्तृत ज्ञानवर्धक जानकारी प्रदान की और अभ्यास भी करवाया।

इस कार्यशाला में कुल 39 प्रतिभागियों ने भाग लिया। श्री. मनोहर एल वाणियर, वरिष्ठ प्रधान, कार्मिक व सामान्य प्रशासन ने कार्यशाला के समापन समारोह की अध्यक्षता की। उन्होंने सभी प्रतिभागियों से अपील किया कि अपना दैनंदिन शासकीय





कार्य हिंदी में करें और अपने सहकर्मियों के साथ हिंदी में वार्तालाप करें तथा आकस्मिक अवकाश, अर्जित अवकाश, चिकित्सा बिल, भविष्य निधि, अग्रिम आवेदन आदि मुद्रित प्रपत्रों को हिंदी में भरें। तदनंतर वरिष्ठ प्रधान, कार्मिक व सामान्य प्रशासन ने अपने कर-कमलों से सभी प्रतिभागियों को प्रमाण पत्र प्रदान किया और साथ ही उन्होंने हिंदी अनुभाग के सभी राजभाषा पदाधिकारियों को भी, कार्यशाला के सफल आयोजन के लिए बधाई दी।

कार्यशाला के अंत में श्री शारिख, वरिष्ठ सहायक ने सभी का आभार प्रकट किया।

नराकास - राजभाषा अधिकारियों की बैठक

आईज़ेक को नगर राजभाषा कार्यान्वयन समिति (का.1), बेंगलूरु का कार्यभार सौंपा गया है तथा 82 सदस्य कार्यालय इस समिति के अधीन हैं। डॉ. एम. अण्णादुरै, निदेशक, आईज़ेक समिति के अध्यक्ष एवं श्रीमती गीता प्रसाद, हिन्दी अधिकारी को सदस्य सचिव के रुप में नामित किया गया है। श्री मनोहर एल. वाणियर, वरिष्ठ प्रधान कार्मिक व सामान्य प्रशासन की अध्यक्षता में दिनांक 16 जून 2017 को सदस्य कार्यालयों के राजभाषा अधिकारी/प्रतिनिधियों की बैठक का आयोजन किया गया। बैठक के दौरान वरिष्ठ का.व.सा.प्र. ने मुख्य रुप से इस बात पर बल दिया गया कि नराकास के तत्वावधान में राजभाषा कार्यान्वयन को उसके प्रगति के पथ पर ले जाने हेतु सक्रिय रुप से सभी सदस्य कार्यालयों को एकजुट होकर काम करना, ताकि राजभाषा को नराकास (का.1) के जरिए उसके उचित स्थान पर विराजमान करवाया जा सके।

आईज़ेक राजभाषा कार्यान्वयन समिति बैठक

निदेशक, आईज़ेक की अध्यक्षता में 17 अप्रैल 2017 को केन्द्र में राजभाषा कार्यान्वयन समिति की 126वीं बैठक का आयोजन किया गया। बैठक के दौरान केंद्र में राजभाषा कार्यान्वयन को और अधिक प्रभावी बनाने हेतु महत्वपूर्ण निर्णय लिए गए।

राजभाषा निरीक्षण

हिंदी के प्रगामी प्रयोग के बारे में 07 जून 2017 को श्री टेकचंद, उप निदेशक, क्षेत्रीय कार्यान्वयन कार्यालय, बेंगलूरु द्वारा आईज़ेक का निरीक्षण किया गया। बैठक के दौरान उप निदेशक, क्षे.का.का. ने आईज़ेक में हिंदी के प्रगामी प्रयोग की दिशा में हो रहे उत्कृष्ट कार्यान्वयन की भरसक सराहना की एवं इसे इसी तरह जारी रखने के लिए कहा।

मासिक प्रतियोगिताएँ

अप्रैल 2017

संघ सरकार की नीति के अनुसार राजभाषा के प्रचार-प्रसार एंव विकास की गति बढ़ाने हेतु 11 अप्रैल 2017 को केन्द्र के वाहन चालक एवं कैटरिंग पदाधिकारियों के लिए हिंदी पाठन प्रतियोगिता का आयोजन किया गया। श्रीमती सुजाता कुमारी एम., वरिष्ठ हिंदी अनुवादक तथा श्रीमती नलिनि प्रकाश एम.एस., कनिष्ठ हिंदी अनुवादक उक्त प्रतियोगिता के निर्णायक रहे। प्रतिभागियों ने बड़े ही उत्साह से प्रतियोगिता में भाग लिया और पुरस्कार प्राप्त किया, सभी विजेताओं को हार्दिक बधाई।

मई 2017

केन्द्र में 26 मई 2017 को पहली बार विशेषकर प्रशासनिक क्षेत्र (प्रशासन, लेखा, क्रय, भण्डार) के अधिकारियों के लिए **हिंदी प्रश्नोत्तरी प्रतियोगिता** का आयोजन किया गया। डॉ. एस.एन. महेश, वरिष्ठ हिंदी अनुवादक एवं श्री डी. संतोष, तकनीकी अधिकारी, कृत्रिम ज्ञान तथा रोबोटिकी केंद्र, रक्षा मंत्रालय, सी.वी. रामन नगर ने उक्त प्रतियोगिता का संचालन किया। यह टीम प्रतियोगिता थी। प्रतिभागियों को अलग-अलग विषयों पर प्रश्न पूछे गए। सभी ने बड़े ही उत्साह से प्रतियोगिता में भाग लिया तथा पुरस्कार प्राप्त किया, सभी विजेताओं को हार्दिक बधाई।

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